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CONTENTS

BROADCASTING MUSICAL STANDARD PITCH

At the request of a number of musical organizations the Bureau has arranged a test radio broadcast of the musician's standard "A" tone of 440 cycles per second. The broadcast is intended for reception by musicians' musical instrument manufacturers, piano tuners, and others having need for an accurate standard of pitch. The standard A pitch will be broadcast simultaneously on frequencies of 5,000, 10,000, and 15,000 kilocycles per second. The older broadcast radio receivers will not receive these frequencies, but most of the more recent sets and the "short-wave" or "all-wave" receivers will. The standard pitch will be broadcast continuously day and night for 2 weeks August 29 to September 12, inclusive) except from noon to 3.30 p. m. E. S. T., on Tuesdays, Wednesdays, and Fridays, using a low-power transmitting set.

Depending upon the results of the 2 weeks' test, the Bureau may later arrange for regular broadcasting of the standard pitch. Persons desiring this service are requested to listen in during these tests and to write the Bureau, reporting on the reception and expressing their ideas on the usefulness of such broadcasts. More specific information about the test broadcasts may be obtained by writing to the Radio Section of the National Bureau of Standards, Washington, D. C.

PHOTOELECTRIC "COLORIMETERS"

A new Letter Circular, LC473, has been prepared by the Bureau's Colorimetry Section on photoelectric "colorimeters" instruments which depend for their operation on the recently developed 'barrier-layer" type of photoelectric cell. These are sold as "colorimeters", "color matchers", "color comparators", or "color analyzers", while similar instruments are used to measure transmission, reflectance, opacity, turbidity, and other optical properties.

It is pointed out that the relative speed and simplicity of operation of these instruments has made them de-

servedly popular. However, it is to be remembered that these devices are valuable in proportion as they give results in accord with visual observations. Their limitations must, therefore, be carefully considered.

Four factors bearing on this subject are discussed: (1) The use of the photoelectric cell to determine values of luminous quantities; (2) its use with spectral filters in abridged spectrophotometry; (3) its use in the various types of "colorimeters"; and (4) miscellaneous factors affecting the reliability of such instruments.

The text is accompanied by numerous footnotes giving references to practically all the publications on which the conclusions are based.

A limited number of copies of this Letter Circular are available to those engaged in the field of color and other optical measurements. Requests should be addressed to the Colorimetry Section, National Bureau of Standards, Washington, D. C.

NEW BOOK ON THERMOCHEMISTRY

"Thermochemistry of the Chemical Substances" is the title of a new book by Dr. F. R. Bichowsky and Dr. F. D. Rossini, which has just come from the press of the Reinhold Publishing Co., New York, N. Y. Interest in this subject has increased so much that a systematic treatment of it was called for, and this has been attempted in the present work for the first time. Doctor Rossini has been engaged for several years in thermochemical researchers at the Bureau, particularly the fractionation of petroleum into its constituent hydrocarbons—work that has been mentioned several times in this Bulletin.

PRECISION ATTAINABLE IN KNOCK RATING OF FUELS FOR INTERNAL-COMBUSTION ENGINES

The Bureau has completed an analysis of data obtained in cooperative knock ratings of fuels for internal-combustion engines, to determine the normal experimental error and the factors affecting the precision of rating. The work was requested by the Cooperative Fuel Research Steering Committee.

This analysis is based on 2,180 tests of 99 fuels. For 1,882 tests made under the standard procedure, the probable error for the average of these fuels is 0.465 octane unit. The precision of rating is very nearly the same for straight-run gasolines, for blends of straight-run and cracked, and for leaded fuels of any base. The experimental error is distinctly larger for nonleaded cracked gasolines, and is still greater for benzol blends. Over the range of commercial fuels the error of rating decreases with increasing octane number, being 0.5 unit at 55 octane number, and 0.4 unit at 75 octane number. From a consideration of the data it appears that the probable error can be kept down to 0.25 octane unit with present equipment if suitable precautions are observed.

Within the ranges covered by the tests analyzed, the result of a knock rating is not affected materially by ambient air temperature or barometric pressure, or dry-air pressure. The octane number obtained in a rating varies in some cases with humidity. The knock rating of sensitive fuels decreases as engine carbon increases. Variations in the intensity of knock used in testing contribute materially to the error of rating. From this analysis the indications are that the precision of knock ratings might be improved by the use of conditioned air and limitation of the period between engine overhauls to 50 hours, at least when testing sensitive fuels.

CARBON-MONOXIDE INDICATORS FOR AIRCRAFT

In cooperation with the National Advisory Committee for Aeronautics, the Bureau has modified some commercially available carbon-monoxide indicators so as to make them more suitable for use in aircraft. These changes include an automatic regulator of the flow of the sample, remounting the parts so as to reduce the weight and size, and the substitution of an external source of suction, as a venturi tube, for the vacuum pump. An alarm has been developed which sounds when the carbon monoxide concentration exceeds 0.02 percent. A method of testing has also been developed in which a standard sample of carbon monoxide is used.

The maximum amount of carbon monoxide in air to which a person may be exposed without harm for 1 hour is 0.04 percent at the ground level, and falls off with altitude. Carbon monoxide in quantities dangerous to personnel may be present in the cockpits of airplanes or in the engine nacelles of airships. This may come about by a leak in an exhaust line, when the exhaust from the engine is used to heat a cabin or compartment, or be caused by the flow of exhaust gases into the cockpit of an airplane by an unfore-

seen condition of airflow. It is, therefore, highly desirable to have available a carbon-monoxide indicator suitable for use in aircraft. In some cases a continuous indication is desired; in others merely a test to insure that the airflow about the aircraft is not such as to carry the engine exhaust into the cockpit or cabin. Both requirements have been met as a result of this work. A more complete account of the project will be found in Technical Note TN573 of the National Advisory Committee for Aeronautics.

A NEW REFERENCE GAS METER

Upon invitation the Bureau cooperated with the Peoples Gas Light and Coke Co. and the Chicago District Pipe Line Co. in the development and construction of a reference gas meter which may be operated over a wide range of rates of flow. Some of the more important attributes of the meter, which are set forth in detail in the August number of the Journal of Research (RP908), are:

1. It is a proportional type meter.
2. It may be operated under pressures up to 600 lb./in^2.
3. At any given line pressure the calculated safe maximum capacity is nearly 300 times minimum capacity at which the meter may be operated conveniently.
4. The indications of the meter are not affected by pulsations in the gas stream.

Unlike most proportional meters, the proportioning ratio may be varied rather readily from about 5 to 1 to about 60 to 1. The actual proportioning ratio being used at any one time is determined by a thermal method, as follows: Two heat exchangers, one in each gas stream, receive heat through the medium of hot water from a common source. The rates of flow of hot water to these heat exchangers are adjusted until the temperatures of the outlet streams are the same. These outlet water streams are discharged into weighing tanks, from which the ratio between their rates of flow is obtained.

Simultaneously the rates of flow of the gas in the two streams are adjusted to bring their tempertures together on the outlet side of the heat exchangers. Hence, if the two gas streams are warmed through one temperature range, while the two water streams are cooled through another temperature range, the ratio of the mass rates of flow of the gas streams will be equal to the mass rates of flow of the water streams.

The rate of flow in the small gas stream is measured with a large piston meter. This piston meter is operated automatically by external power so that the pressure drop through it is extremely small. When using this meter it is quite easy to start and end a test so that an even whole number of piston strokes is included. The temperature of the piston meter is carefully controlled with a water bath, and the gas pressure within it is measured with a piston type pressure gage. The specific gravity of the gas, referred to air, is determined with auxiliary equipment. Thus, having determined the duration of the test, the total displacement of the piston meter, and the pressure, temperature, and specific gravity of the gas, it is possible to compute the mass rate of flow of gas through the small branch.

If w_s (lb/sec) represents the rate of flow through the small branch, and C_m represents the ratio of the rates of flow in the two streams as determined from the weights of water, then the total rate of flow of gas into the meter, w (lb/sec) will be given by

$$w = w_s\,(C_m + 1).$$

After completing the Joliet reference meter, it was used in making 15 tests on an orifice meter. Of these tests the maximum departure from the average was about 0.4 percent, and the average departure was ± 0.16 percent. These tests and the operation of the two meters have been carefully checked and analyzed. It appears probable that, excepting for the determination of specific gravity, the effect upon the indicated rate of flow through the reference meter of uncertainties in the determination or regulation of any factor would not exceed ± 0.05 percent. (The uncertainty in the specific gravity determination might amount to from 0.1 to 0.15 percent.)

SCOUR OF A SANDY RIVER BED BY CLEAR AND BY MUDDY WATER

At the request of the U. S. Bureau of Reclamation an experimental study was made in the hydraulic laboratory of the National Bureau of Standards of the scour produced in a bed of fine sand in a sloping flume by muddy water, as compared to clear water. The experimental conditions simulated

those existing in the Colorado River at the Boulder Dam before and after construction. It was found that, when the water contained an appreciable amount of clay in suspension, an increase of about 10 percent in mean velocity of the water was necessary to scour out the same amount of Colorado sand as was scoured by clear water. For coarser sands this increase in velocity was greater.

Velocities characteristic of critical movement of the sand bed were found greater for muddy water than for clear water.

It was concluded that clear water discharged at the Boulder Dam will cause more scour of the river bed below the dam than the muddy water of the river before the dam was built.

The complete report of this investigation will be published as RP907 in the August number of the Journal of Research.

SOLUBLE DECOMPOSITION PRODUCTS IN AGED VEGETABLE-TANNED LEATHERS

For the past few years the Bureau has studied the effect of sulphuric acid on leather. Leathers of different tannages and containing various leather making materials were treated and aged under different conditions. The deterioration in the presence of sulphuric acid was accompanied by the formation of soluble nitrogen compounds, among which were ammonia and compounds containing free amino nitrogen. As a means of studying the mechanism of deterioration and to obtain some data for an accelerated aging test, a study was made of the soluble nitrogen compounds in these leathers.

The results, as given in RP909 in the August number of the Journal of Research, indicate that most of the deterioration is caused by hydrolysis. The hydrolysis, however, is not complete, since only small amounts of amino nitrogen are formed. The amount of ammonia present shows no relationship with the loss in tensile strength or the percentage of total soluble nitrogen.

LOAD DISTRIBUTION AND STRENGTH OF ELEVATOR CABLE EQUALIZERS

Most elevator cars are supported by two or more wire ropes, and on their strength the safety of the passengers largely depends. These supporting ropes are designed to carry a car with a liberal margin of safety, provided the load is equally distributed among them. Although the ropes are of equal length when installed and the load on each rope is adjusted (by means of threaded shackles) to be as nearly uniform as possible when new cables are put in service, these loads do not remain uniform except in a very few instances. All wire ropes stretch appreciably under load and in addition there is a gradual lengthening, which may continue for months or even years. For ropes of the usual construction, this stretch amounts to about 1 percent of the length of the rope under loadings ordinarily used in elevator practice. However, the stretch of two identical lengths of wire rope under equal loading will seldom be the same. This may be due to variations in the wires of which the strands are made, to variations in the tightness of the lay, to variations in the core, or to other causes. In the case of elevator ropes the distance between the cross head of the car and the cable anchorage on the counter weight remains substantially the same, with the result that the tendency of the ropes to stretch different amounts results in unequal forces on the ropes.

Several companies have put on the market devices called elevator-cable equalizers designed to remedy this condition. Such an equalizer is attached to the top of the car, the ropes being attached to the equalizer shackles. The shackles travel up and down as the cable lengths change, and the equalizer mechanism is designed so that, neglecting friction, it is in equilibrium only when the loads on the shackles, and hence the tensions in the cables, are all equal.

The effectiveness of various equalizers has been studied at the Bureau. Steel rods of adjustable length representing the cables were attached to the equalizer shackles and loaded in a testing machine. The distribution of load among the various rods was then measured for various degrees of inequality of rod lengths. The tension in each rod was calculated from the stretch of the rod as observed with Tuckerman optical strain gages.

RP912 in the August number of the Journal of Research gives the results of these tests, as well as those of tests made on the strength of the equalizers, the limits of travel of the shackles, and the effect of varying the total car weight on the equalizing characteristics.

COPPER WIRE TABLES

The Bureau is glad to announce that, in view of the continuing demand

for Circular C31, Copper Wire Tables, it has been found possible to reprint this publication, which has not been available for several years. Copies may soon be purchased from the Government Printing Office. The price will be 20¢ a copy.

The tables in Circular C31 are in terms of the international standard values for the electrical resistivity, temperature coefficient, and density of copper, which were adopted in 1913 by the International Electrotechnical Commission and were based on research in the Bureau's laboratories. The history of the standard values is discussed.

Considerable attention is given to the subject of wire gages, including a brief history of their development, trend of practice at the time the Circular was prepared, and a detailed consideration of the American Wire Gage.

The tables are comprehensive and include, besides tables giving the relations of resistance, length, and mass for standard sizes, tables of standard resistivities and temperature coefficients, wire gages, cables, and aluminum wire. The data are duplicated in English and metric units.

Certain auxiliary questions, treated in appendices, include: (1) The expression of the various kinds of resistivity and units thereof; (2) calculation of the constant connecting the change of resistivity with the temperature, from the known law of proportionality between temperature coefficient and conductivity; (3) data on the density of copper; (4) calculation of the resistance and mass of cables; and (5) the international standard of resistance for copper.

YOUNG'S MODULUS OF ELASTICITY, STRENGTH, AND EXTENSIBILITY OF REFRACTORIES IN TENSION

The brittleness of refractory products has in the past been a serious handicap to the study of their tensile properties. Within recent years the development of the optical strain gage for measuring minute length changes has given the research worker a tool which has eliminated most of the difficulties encountered in such a study, so that strain measurements of all types of refractory materials can be made with reasonable accuracy.

Although refractories are ordinarily subjected to comparatively small external loads, more information on their little known structural properties may lead to a better understanding of their behavior in certain types of service. A knowledge of the tensile properties of fired refractory products is desirable because of the trend toward the use of fairly large shapes in hanging roofs designed for modern high-power boiler settings, heat-treating and other furnaces. Also there is often a decided lack of agreement in results of certain tests of apparently duplicate samples of refractory bricks or shapes.

A study was, therefore, undertaken at the Bureau to make available information on the tensile properties of the standard 9-inch size of firebrick, and also the extent of the variation in these properties within the brick and between bricks. This shape is produced in largest quantities, is readily obtainable, and enables a selection representative of the different localities and processes of manufacture, different degrees of heating, and different methods of setting in the kiln. The specimens used for study were machined from sections, the axes of which were initially lengthwise or crosswise to the brick.

A report has been released for publication giving information on the tensile properties of 16 brands of fire-clay brick, two of high alumina and one each of silica, chrome, forsterite, and mullite. The results of tests made on nine specimens (6 lengthwise and 3 crosswise of the brick) of 3 bricks of each brand show that the range in Young's modulus of elasticity was from 485,000 lb/in.^{2} to 5,255,000 lb/in.^{2}, the range in tensile strength from 115 lb/in.^{2} to 1,005 lb/in.^{2}, and the range in extensibility from 0.0120 to 0.0465 percent. For dry-press bricks Young's modulus of elasticity of the crosswise specimens was greater than that of the lengthwise specimens; for stiff-mud extruded brick the modulus was less for the crosswise specimens than that for the lengthwise; and for the handmade brick the moduli of elasticity of the crosswise and lengthwise specimens were nearly the same. The handmade bricks showed more variation in properties from one brick to the next than either the dry-press or stiff-mud bricks. However, the range in maximum and minimum values for individual handmade bricks was less than that for the other two types.

In general, bricks formed by the dry-press process had greater extensibilities than those formed by either the handmade or stiff-mud process. The highly siliceous fire-clay brick and the silica brick, each having higher silica content than the other brands, and both made by the handmade process, had higher

extensibilities than any of the other brands.

Results of tests limited to one brand of dry-press bricks indicate that tensile properties of specimens cut from the bricks after firing are significantly affected by axial load during firing of the bricks in the kiln.

ACID RESISTANCE OF VITREOUS ENAMELS

The acid resistance of vitreous or porcelain enamels has received increasing attention in recent years, and various tests have been used to determine the degree of resistance of different enamels. As a part of its general program of cooperation with the Porcelain Enamel Institute, the Bureau has been engaged in developing a test which will merit adoption as a standard.

The results of investigative work indicated that no satisfactory distinction could be made between enamels of varying acid resistance by determining the least concentration of a given acid which would cause visable attack under specified conditions—that is, the "threshold" concentration. Seven concentrations of citric acid were used, the strongest being 64 times the concentration of the weakest. Some enamels were not affected by any of the solutions, some were slightly affected by all, and those readily attacked were etched by even the weakest solution.

Another test method, namely, determining the degree of attack caused by a specified treatment with acid, gave promising results. For articles to be used at room temperature the treatment consisted of contact with 10-percent citric acid at room temperature for 15 minutes. For cooking utensils the treatment consisted of contact with a boiling solution of 2.5-percent malic acid for half an hour. Three degrees of attack could be distinguished visually:

(a) No visible attack.
(b) Attack visible, but insufficient to decrease ease of erasure of a pencil mark.
(c) Attack sufficient to prevent erasure of a pencil mark with a wet cloth.

While these three classes may be sufficient for commercial classification, research work requires the detection of numerous degrees of acid resistance. For this purpose the loss of specular (mirror) reflection caused by the acid, as determined by a Hunter glossmeter, was taken as a criterion of the resistance. The following table illustrates the results obtained with specimens of a wide range of acid resistance.

Specimen	Specular reflection index		Specimen	Specular reflection index	
	Original[1] value	Percentage of original after treatment		Original[1] value	Percentage of original after treatment
		Percent			*Percent*
1	65	100	4	50	19
2	49	84	5	60	8
3	48	48			

[1] Percentage × 10, thus an index value of 65 is equal to 6.5 percent.

ERRORS IN JULY NUMBER

Several errors occurred in the July number of the Technical News Bulletin, some of which are serious enough to warrant correcting them.

On page 60, first column, sixth line, "others" should read "ethers." On the same page, under "Safety Glass", a line has been left out of the second paragraph, which should read: "The preparation of this safety code was sponsored by the Bureau and the National Bureau of Casualty and Surety Underwriters, and the tests include those for resistance to impact as determined by dropping * * *."

On page 61, the right side of the equation should read: "R minus 6.5, divided by 0.3 minus 0.08R, plus 1234."

Directly under the equation on page 64, the sentence should read: "The values of A divided by μ^3 are about twice the theoretical hydrogen values."

The heading "Mimeographed Material" on page 66 is out of place. It should be placed directly over "Letter Circulars."

NEW AND REVISED PUBLICATIONS ISSUED DURING JULY 1936

Journal of Research [1]

Journal of Research of the National Bureau of Standards, vol. 17, no. 1, July 1936 (RP 899 to RP 906, inclusive). Price, 25 cents. Obtainable by subscription.

Research Papers [1]

[Reprints from the April and May 1936 Journal of Research]

RP877. Evaluation of ultraviolet solar radiation of short wave lengths. W. W. Coblentz and R. Stair. Price, 5 cents.

RP878. Simplified apparatus for technical sugar colorimetry. Joseph F. Brewster. Price, 5 cents.

RP879. Gloss investigations using reflected images of a target pattern. Richard S. Hunter. Price, 5 cents.

RP880. An improved method for preparing cast-iron transverse test bars. A. I. Krynitsky and C. M. Saeger, Jr. Price, 5 cents.

RP881. Arc and spark spectra of columbian. William F. Meggers and Arthur S. King. Price, 5 cents.

RP882. Routine determination of boron in glass. Francis W. Glaze and A. N. Finn. Price, 5 cents.

RP883. Soil corrosion studies, 1934. Rate of loss of weight and pitting of ferrous specimens. K. H. Logan. Price, 5 cents.

RP884. Studies of the quarternary system CaO-MgO-$2CaO.SiO_2$-$5CaO.3Al_2O_3$. H. F. McMurdie and Herbert Insley. Price, 5 cents.

RP885. Mechanism of the sulfur lability in the alkali degredation of wool protein. J. A. Crowder and Milton Harris. Price 5 cents.

RP886. A modified accelerated weathering test for asphalts and other materials. O. G. Strieter and H. R. Snoke. Price 5 cents.

Technical News Bulletin [1]

Technical News Bulletin 231, July 1936. Price 5 cents. Obtainable by subscription.

[1] Send orders for publications under this heading only to Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, $2.50 per year (United States and its possessions, and Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 70 cents and $3.25, respectively.

MIMEOGRAPHED MATERIAL

Letter Circulars

Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards, and are sent only on request to persons having definite need for the information. The number of copies available is limited. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or to send copies automatically as issued.

LC473. Photoelectric colorimeters.

Technical Information on Building Materials

The supply of these notes, each of which consists of 3 or 4 pages giving the important facts on some one aspect of the properties or use of building materials, is necessarily limited. Their distribution will be confined to Government officials concerned with building projects, and to architects, engineers, and home builders. Requests should make clear the actual need for the information at the time of writing. Letters should be addressed to the Division of Codes and Specifications, National Bureau of Standards, Washington, D. C. The following notes have been issued since the list published in the July 1936 number of the Technical News Bulletin:

TIBM–24. Plastic caulking and pointing materials.

TIBM–25. Wall plaster and plastering: Plaster bases and furring.

TIBM–26. Wall plaster mixing and application.

TIBM–27. The hardened wall plaster.

TIBM–28. Painting of ferrous metals.

TIBM–29. Corrosion of ferrous metals underground.

Hydraulic Laboratory Bulletin

Copies are sent only in answer to specific requests addressed to the Hydraulic Laboratory, National Bureau of Standards, Washington, D. C.

Current hydraulic laboratory research in the United States. Bulletin IV–2 (July 1, 1936).

OUTSIDE PUBLICATIONS [2]

International Committee on Weights and Measures decides on new basis

[2] These publications are not obtainable from the Government unless otherwise noted. Requests should be sent direct to the publishers.

for electrical units. E. C. Crittenden. Ind. Stdzn. and Comm. Stds. Mo. (29 W. 39 St., New York, N. Y.), 7, 110 (May 1936).

High-frequency radio fadeouts continue. J. H. Dellinger. QST (38 LaSalle Road, West Hartford, Conn.). 20, 37 (June 1936).

A unicontrol radio receiver for ultra-high frequencies using concentric lines as interstage couplers. Francis W. Dunmore. Proc. Inst. Radio Engineers (33 W. 39 St., New York, N. Y.), 24, 837 (June 1936).

Radio field intensity and distance characteristics of a high vertical broadcast antenna. Samuel S. Kirby. Proc. Inst. Radio Engineers, 24, 859 (June 1936).

Further studies of flame movement and pressure development in an engine cylinder. Charles F. Marvin, Jr., Armistead Wharton, and Carl H. Roeder. Tech. Rep. 556 (Natl. Advisory Comm. Aeronaut., Washington, D. C.), (June 1936). (Obtainable at 10 cents a copy from the Superintendent of Documents, Government Printing Office, Washington, D. C.)

Color blindness and anomalies of vision. Deane B. Judd. J. Soc. Motion Picture Engineers (33 W. 42 St., New York, N. Y.), 26, 616 (June 1936).

A method for determining whiteness of paper, II. Deane B. Judd. Tech. Assn. Papers (Tech. Assn. Pulp and Paper Industry, 122 E. 42 St., New York, N. Y.), 19, 359 (1936).

The differential method of measuring density by means of twin pycnometers. Edgar R. Smith and Mieczyslaw Wojciechowski. Roczniki Chem. (Roczniki Chemji, Polskie Towarzystow Chemiczne Politechnika, Polna 3, Warsaw, Poland), 16, 104 (1936); Bul. Int. Acad. Polonaise Classe Sci. Math. Nat. (Gebethner et Wolff, Rynek, Glówny, Cracow, Poland). (March 1936.)

Corrosion of metal bridges used in moistening troughs on full-fashioned knitting machines, its causes, and means for eliminating it. E. M. Schenke. (1936.) Research and Year Book (Natl. Assn. Hosiery Mfgrs., 468 Fourth Ave., New York, N. Y.), page 45 (1936).

Machine tests will help women select best wearing shoes. R. C. Bowker. Ind. Stdzn. and Comm. Stds. Mo. 7, 104 (May 1936).

Plastics and the tin can industry. G. M. Kline. Modern Plastics (425 Fourth Ave., New York, N. Y.) 13, 36 (June 1936).

Factors of workability of concrete. W. H. Herschel and E. A. Pisapia. J. Am. Concrete Inst. (7400 Second Blvd., Detroit, Mich.), 7, 641 (May-June 1936).

Building exits. George N. Thompson. Building Stds. Mo. (Pacific Coast Bldg. Officials' Conference, 124 W. 4 St., Los Angeles, Calif.), 5, 3 (May 1936).

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